The Role of Salps for Carbon Export in the Southern Ocean

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Questions

- Will digestion of salps change with food concentration and food composition?
- How will this be reflected in the export quality of salp faeces?

Project Hypothesis

- The pigment gut content of salps varies seasonally
- *Ihlea racovitzai* and *Salpa thompsoni* occupy different food niches
- Low available food concentrations result in poor quality of egested material

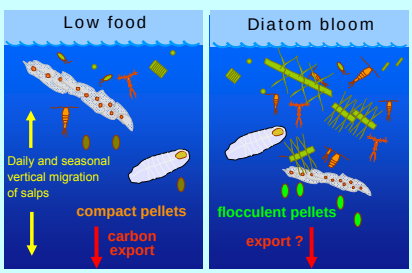


Fig. 1: Potential carbon export by salp fecal pellets

Study Sites and Methods

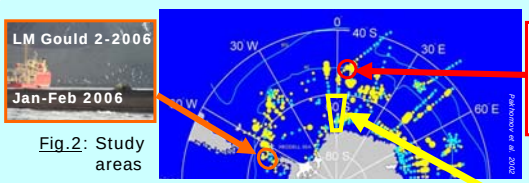


Fig.2: Study areas

EIFEX European Iron Fertilization Experiment Jan-March 2004

LAKRIS Lazarev Krill Study
March-April 2004
Nov-Jan 2005/06
July-Aug 2006
Dec-Feb 2007/08

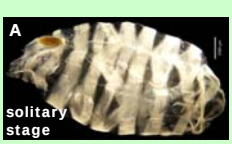
EIFEX
- Pigment analysis of water masses inside and outside bloom area some down to bottom water by HPLC (High Performance Liquid Chromatography)
- Gut pigment analysis of salps (*S. thompsoni*) from low and high chlorophyll areas
- Incubation experiments of *S. thompsoni* for fecal pellet studies

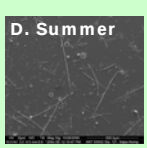
LM Gould
- HPLC pigment data acquisition of salp guts (*S. thompsoni*) and ambient waters
- Feeding rates of *S. thompsoni* determined in incubation experiments

LAKRIS
- HPLC pigment data acquisition of salp guts (*S. thompsoni* and *I. racovitzai*) and ambient waters from all year round LAKRIS cruises
- Gut content analysis by microscopy and POC/PON measurements

Salp Gut Contents

Ihlea racovitzai
- small, greenish guts
- no microscopic evidence of seasonal diet change





Salpa thompsoni
- large redish guts
- strong seasonality

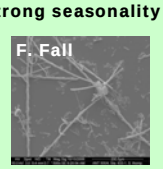
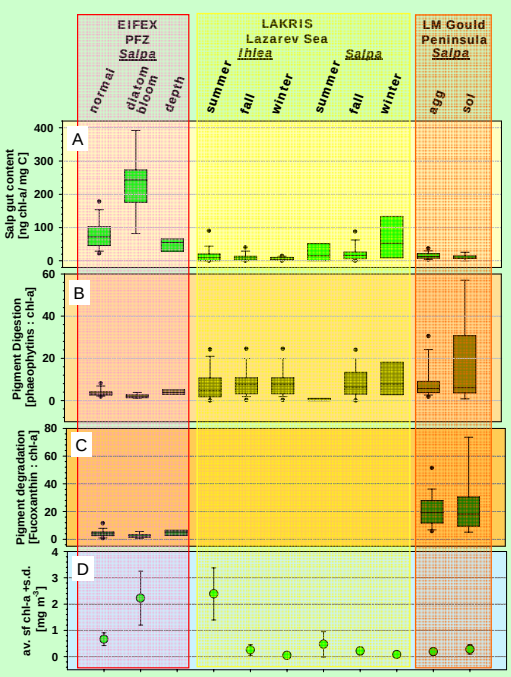


Fig. 4: A-C) Southern Ocean salps D-G) SEM examples of salp gut content of different seasons

Pigment Degradation in Salp Guts



Changing Quality of Fecal Pellets

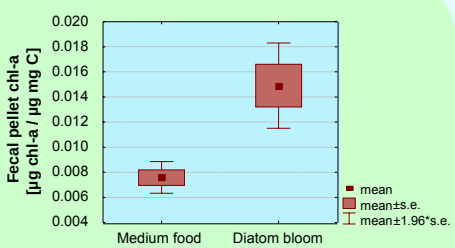


Fig. 6: Chlorophyll content of fecal pellets egested during incubation experiments with *S. thompsoni* in fall 2004 (EIFEX)

Carbon Export by Fecal Pellets

- Estimates of *S. thompsoni* pellets based on average salp biomass and defecation rates:
- ~ up to 0.95 mg C m^{-2} in fall 2004, Lazarev Sea
- ~ up to 4-20 mg C m^{-2} in summer 2006, Western Peninsula region (*Phillips et al. 2009*)

Fig. 5: Box plots (median and 5th/95th percentile) A) Salp gut chlorophyll contents. B) Ratio of degradation product Phaeophytin and Pyro-phaeophytin to chl-a. C) Ratio of fucoxanthin as pigment marker for diatoms to chl-a. D) Average surface chlorophyll (av. sf chl-a) conc. (10, 20 and 50 m) of ambient waters

Results

- *Salpa thompsoni* shows high variation in gut content concentrations and digestion efficiency is reduced in diatom blooms.
- Pigments reflect different feeding and/or digestion:
  - *I. racovitzai* → low seasonal variability in Lazarev Sea
  - *S. thomsponi* → high seasonality and geographical differences
- Fecal pellets of *S. thompsoni* contain high amounts of undigested chl-a in high food areas

Conclusions

- Results suggests different diets of the two salps
- No clear signal between digestion efficiency and food concentration is evident
- Food quality strongly affects degradation of ingested material

Further Studies

- Is the varying local phytoplankton distributions reflected in the gut pigment content of salps ?
- What do salps feed in winter time at extreme low phytoplankton concentrations ?
- Are there regio-ecologically relevant differences found in the two salp species ?

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